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Published in:
Book of Abstracts Sustain 2017

Publication date:
2017

Document Version
Publisher's PDF, also known as Version of record

Bioenergy conversion and storage systems: from conventional electrochemical cells to hybrid bioelectronic devices

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The rapid development and popularization of wearable and implantable self-sustainable electronics has increasingly demanded new-generation miniature and biocompatible power systems that can function under near-neutral pH solution and ambient conditions. Towards this end, enzymatic fuel cells (EFCs) using biocatalysts can offer an effective alternative to conventional batteries or fuel cells attributed to high biocatalytic activity, substrate specified selectivity, and non-toxic end products with ecofriendly impacts. Newly emerging photobioelectrochemical cells (PBCs), exploiting photosynthetic machinery for direct conversion of solar energy into electric power, is one of the most promising prospects for green and self-sustainable energy harvesting [1]. In addition, utilizing the inherent capacitance of electrodes as an active charge-storing element enables to enhance the efficiency of electron transfer processes proceeding in the system [2] and further miniaturization and simplification of a full-function device by elimination of internal capacitors in the electronic circuit. Remarkably, some pioneering attempts to design and create hybrid bioelectrochemical cells have already shown the positive prospects of such an approach, which was not able to achieve previously [3]. This invited talk aims to overview recent developments of EFCs and PBCs. In particular, we highlight their advantages, drawbacks and future perspectives towards practical applications.

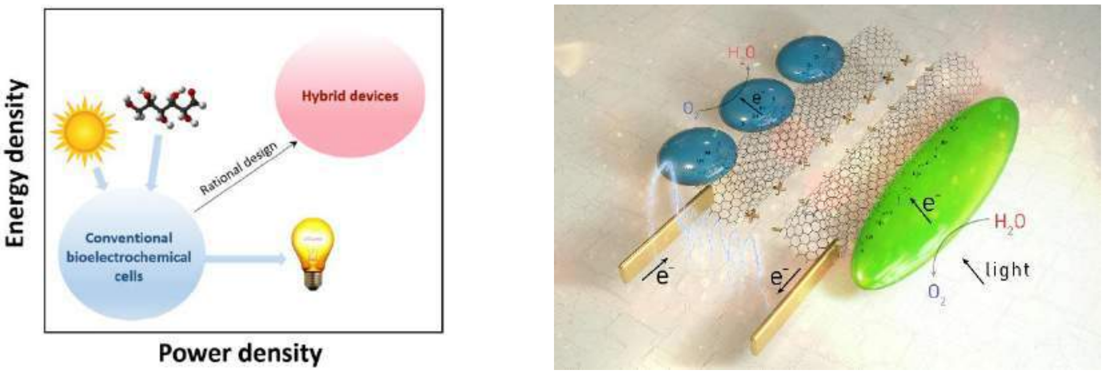

Fig. 1. Left: Schematic Ragone plot for conventional and hybrid bioelectrochemical cells. Right: Schematic representation of a hybrid PBC employing a photobioanode and an enzymatic biocathode.

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Acknowledgments

This work was financially supported by the Marie Curie Actions under REA Grant Agreement No. 609405 (Ørsted-COFUND Postdoc fellowship at DTU). Q. C. acknowledges the financial support by Independent Research Fund Denmark-Nature Sciences (DFF-FNU, Project No. DFF-7014-00302).